Roll No. 20311230006 Exam Code : M-23

Subject Code—59295

B. Sc. EXAMINATION

(Main/Re-appear) (Batch 2018 Onwards)

(Sixth Semester)

MATHEMATICS

CML-606(i)

Mechanics—II

Time : 3 *Hours* *Maximum Marks* : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

Compulsory Question

1. (a) What is third form for system of coplanar forces shall be in equilibrium ? 2

   (b) What is static and dynamic friction ? 2

(c) Find centre of gravity for thin uniform triangular Lamina. 2

(d) Define Hooke's law. 2

(e) What is Power ? Define one watt. 2

(f) What is kinetic and Potential Energy ? Explain with examples. 3

(g) A particle is projected with a velocity 49 m/sec in a direction making an angle of 45° with horizontal. Find : 3

(i) Time of flight

(ii) Horizontal Range

(iii) Greatest Height

Unit I

2. (a) A uniform rod AB of weight w and length $2a$ is hinged at A to a fixed point by means of smooth hinge it is kept at rest inclined at an angle α to the vertical by means of a force F applied horizontally at B. Find the magnitude and direction of the reaction at the hinge on the rod

and show that the magnitude of F is

$\frac{1}{2} w \tan \alpha$. 8

(b) Find the centre of gravity of the arc of the asteroid : 8

$$x^{2/3} + y^{2/3} = a^{2/3}$$

lying in the first quadrant.

3. (a) Two equal heavy rods of weight W and length $2a$ are freely hinged together and placed symmetrically over a smooth sphere of a radius r. Show that the inclination of each rod to the horizontal is given by $r\left(\tan^3 \theta + \tan \theta\right) = a$. 8

(b) One end of heavy uniform rod AB can slide along a rough horizontal rod AC, to which it is attached by a ring. B and C are joined by a string. If ABC be a right angle when the rod is on the point of sliding, μ be co-efficient of friction and β the angle between AB and the

vertical, show that : 8

$$\mu = \frac{\tan\beta}{2+\tan^2\beta}$$

Unit II

4. (a) A light elastic string of natural length l has one end fixed at a point O and the other end attached to a particle, the weight of which in equilibrium position would extend the string length to l_1. Show that if the particles be dropped from rest at O, it will come to instantaneous rest at a depth $\sqrt{l_1^2 - l^2}$ below the equilibrium position. 8

(b) A train of mass M lbs. is ascending a smooth incline of 1 in n and when the velocity of the train is v ft/sec., its acceleration is f ft/sec^2. Prove that the effective horse power of the engine is :

$$\frac{Mv(nf+g)}{550\,ng}$$ 8

5. (a) A bullet fired with a velocity of 1600 ft./ sec. passes through three planks in succession. If it loses a velocity of 400 ft./sec. in passing through each plank, find the ratio of their thickness to which the resistance is supposed to be proportional. 8

(b) An elastic string whose modulus of elasticity is λ is stretched to double its length and tied to two fixed points distant $2a$ apart. A particle of mass m, tied to its middle point is displaced along the line of the string through a distance equal to half its distance from the fixed point and released. Prove that time of complete oscillation is $\pi\sqrt{\frac{am}{\lambda}}$ and maximum velocity acquired is $\sqrt{\frac{a\lambda}{m}}$. 8

Unit III

6. (a) A particle slides down a rough curve under gravity in a vertical plane. Discuss the motion. 8

   (b) A particle slides down the arc of a smooth cycloid, whose axis is vertical and vertex downwards. Discuss the motion. 8

7. A particle slides down the outside of smooth vertical circle starting from rest at the highest point. Discuss the motion. 16

Unit IV

8. (a) A tower of height h stands on a horizontal ground, and a particle is projected with speed u from the top so as to hit the ground at the greatest distance from the foot of the tower. Prove that this distance is $\frac{u}{g}\sqrt{u^2+2gh}$. 8

(b) A particle is projected with a velocity of 80 ft./sec at an angle of 45° to the horizontal. Find its range on a plane inclined to 30° to the horizontal when projected up the plane. 8

9. (a) A particle is thrown over a triangle from one end to of a Horizontal base and grazing the vertex fall over on the other end of the base. If α and β be the base angles and θ the angle of projection; prove that $\tan\theta = \tan\alpha + \tan\beta$. 8

(b) A particle is projected at an angle of elevation α and after t seconds it has angle of elevation β. Show that the horizontal component of initial velocity is $\dfrac{gt}{\tan\alpha - \tan\beta}$. 8